

## DESIGN SPECIFICATIONS FOR OPACITY MONITORS TO BE USED WHERE OPACITY LIMITS ARE LESS THAN 10 PERCENT

### (Conditional Performance Specification 001, CPS-001)

**Note:** This conditional performance specification provides a few variations from the design specifications for opacity monitors specified in ASTM D 6216-98. Otherwise, all requirements specified in D 6216-98 and PS-1 apply. Any procedures described in the conditional performance specification are from ASTM D 6216-98. An opacity monitor built in accordance with the design specifications outlined in this conditional performance specification has been installed on an electric arc furnace where data has been collected for over a year.

1. What are the Background, Purpose, and Applicability of Conditional Performance Specification 001?
  - 1.1 Background. The limitations of the present state of the art opacity monitors are reflected in American Society for Testing and Materials (ASTM) “Standard Practice for Opacity Monitor Manufacturers to Certify Conformance with Design and Performance Specifications,” ASTM D 6216-98, which is incorporated by reference into Performance Specification 1 (PS-1) of 40 CFR Part 60, Appendix B. PS-1 details the performance specifications for opacity monitors. PS-1 recognizes the data uncertainty associated with COMSs used where the opacity limit is less than 10 percent. EPA and ASTM are working jointly to develop performance specifications for opacity monitors capable of accurate measurements less than 10 percent.
  - 1.2 Purpose and Applicability. The purpose of Conditional Performance Specification 001 (CPS-001) is to provide requirements for the design of an opacity monitor capable of measuring accurately below 10 percent and is applicable to sources whose opacity limits are less than 10 percent. CPS-001 must be approved as an alternative monitoring requirement or an alternative test method before a source may use it to meet Federal requirements under 40 CFR Parts 60, 61, and 63. It may be used by State and local programs in conjunction with Federally enforceable programs (e.g., Title V permits, State Implementation Plans (SIPs)) provided they are subject to an EPA Regional SIP approval process or permit veto opportunity and public notice and opportunity for comment. It is available for application without EPA oversight for other non-EPA program uses including state permitting programs and scientific and engineering applications.
  - 1.3 CPS-001 was developed based on data obtained from an opacity monitor using light emitting diodes (LEDs) with a diffuser to generate a single output light source. The principle is to provide a light source that generates a homogeneous light beam for use in an opacity monitor for measuring the opacity of gases in an open path of gases, wherein the light source reduces the variation in light intensity across the beam of light projected.

- 1.4 Utilizing a homogeneous light source enables an opacity monitor:
- (1) To detect opacities less than 10 percent while operating within specific performance requirements. This enables opacity monitors to ensure compliance with opacity limits below 10 percent, and
  - (2) To tolerate small movements of the stack/duct structure due to thermal effects, wind, settling, etc. that can cause the relative position of the retroreflector and the projected light beam to move slightly. A more evenly illuminated light source reduces errors caused by misalignment of the transceiver and retroreflector so that stable, accurate readings can be made at opacity levels below 10 percent.

2. What are the differences between PS-1 and CPS-001?

- 2.1 PS-1, with the incorporation by reference of ASTM D 6216-98, provides the procedure for certifying continuous opacity monitors. It includes design and performance specifications, test procedures, and quality assurance requirements to ensure that continuous opacity monitors meet minimum design and calibration requirements.
- 2.2 CPS-001 offers design specifications, given in paragraphs (1) through (9), to ensure accurate measurements for continuous opacity monitors subject to opacity standards less than 10 percent.
- (1) Supply voltage variation
    - (i) *Specification* – The opacity monitor output (measurement and calibration check responses, both with and without compensation, if applicable) must not deviate more than  $\pm 0.2$  percent single pass opacity for variations in the supply voltage over  $\pm 10$  percent from nominal or the range specified by the manufacturer, whichever is greater.
  - (2) Thermal stability
    - (i) *Specification* – The opacity monitor output (measurement and calibration check responses, both with and without compensation, if applicable) must not deviate more than  $\pm 0.3$  percent single pass opacity for every 22.2EC (40EF) change in ambient temperature over the range specified by the manufacturer.
    - (ii) Establish proper calibration of the instrument using external attenuators at a moderate temperature that is,  $21.1 \pm 2.8$ EC ( $70 \pm 5$ EF). Insert an external attenuator with a single-pass value between 2 and 10 percent opacity into the measurement path and record the response. Initiate a calibration check cycle and record the low level and upscale responses.

- (3) Ambient light
- (i) *Specification* – The opacity monitor output (measurement and calibration check responses, both with and without compensation, if applicable) must not deviate more than  $\pm 0.2$  percent single pass opacity when exposed to ambient sunlight over the course of a day.
  - (ii) Set-up the opacity monitor outside, with the light path in a horizontal position, and where it will be directly exposed to sunlight for the entire day. Use mounting flanges of normal length, and attach the flanges to mounting plates that extend at least 0.305 m (12 in.) above, below, and to both sides of the mounting flanges. Paint the interior surfaces of the mounting flanges and the facing surfaces of the mounting plates white. Optically align the opacity monitor (transceiver and receiver for single-pass opacity monitors) at a measurement pathlength of 3 m on an approximate east-west axis aligned with the transit of the sun. Use a pathlength correction factor of 1.0. Calibrate the instrument using external attenuators prior to the test. Insert an external attenuator with a single-pass value between 2 and 10 percent opacity into the measurement and record the response. Initiate a calibration check cycle and record the low level and upscale responses.
- (4) External zero device
- (i) *Specification* – The opacity monitor output must not deviate more than 0.2 percent single-pass opacity for repeated installations of the external zero device on a transmissometer. After performing the design specification verification procedure, return the transmissometer to operation and verify that the opacity monitor output indicates  $0.0 \pm 0.2$  percent opacity.
- (5) Upscale calibration device
- (i) The upscale calibration device checks the pathlength corrected measurement system response where the energy level reaching the detector is between the energy levels corresponding to 2 percent opacity and the highest level filter used to determine calibration error.
- (6) Calibration error
- (i) *Specification* – The calibration error must be  $\leq 1$  percent opacity as calculated as the sum of the absolute value of the mean difference and confidence coefficient for each of three test attenuators.
- (7) Optical alignment indicator
- (i) *Specification* – The alignment sight must clearly indicate that the unit is misaligned when an error of  $\pm 0.5$  percent single pass opacity occurs due to shifts in the optical alignment of the transmissometer

components.

- (8) Calibration device repeatability
  - (i) *Specification* – The 95 percent confidence coefficient for repeated measurements of the upscale calibration device must be less than 0.3 percent opacity. The upscale calibration device must be assigned a value relative to the calibration error test results for the specific opacity monitor.
  
- (9) Measurement output resolution
  - (i) Certify that the opacity monitor output, including visual measurement displays, analog outputs, or digital outputs, or combination thereof, have a resolution  $\leq 0.1$  percent opacity over the measurement range from - 4.0 percent opacity to 20 percent opacity or higher value.
  - (ii) Certify that the dust accumulation fault indicator is triggered at 2 percent opacity.